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INTERACTION EFFECTS OF DIFFERENT DOSES OF SULPHUR AND ZINC WITH NPK ON PHYSICO – CHEMICAL PROPERTIES OF SOIL IN YELLOW MUSTARD (*BRASSICA COMPESTRIS* L.) CV. KRISHNA SUPER GOLDI

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ABSTRACT

The experiment was carried out at Soil Science research farm SHIATS, Allahabad during rabi season 2014-15. The experiment was laid out in 3×3 factorial randomized block design with three replications, consisting of nine treatments. Treatment T_9 (@ 45 kg Sulphur ha^{-1} + 5.5 kg Zinc ha^{-1}) was to be best in pH, EC, O.C, available nitrogen (kg ha^{-1}), phosphorus (kg ha^{-1}), potassium (kg ha^{-1}), sulphur (kg ha^{-1}) and zinc (kg ha^{-1}) which were as 6.96, 0.24, 0.69 380.24,27.46, 270.72, 28.50, 2.94 respectively. Soil chemical properties as available Nitrogen and Potassium were found to be significant but pH, EC, O C. available Phosphorus, Sulphur and Zinc were found to be non significant. Soil physical properties as particle density (Mg m^{-3}) and pore space (%) were found to be significant where as bulk density (Mg m^{-3}) was found to be non significant.

KEYWORDS: Sulphur, Zinc, NPK, Soil Physico-Chemical Properties, Yellow Mustard

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INTRODUCTION

India is amongst the largest vegetable oil economic in the world. The present average per capita consumption of oils and fats has not been more than 11g/day as against the nutritional standard of 30g/day for a balanced diet. Mustard is rich in minerals like calcium, manganese, copper, iron, selenium, zinc, vitamin A, B, C and proteins. 100g mustard seed contains 508 kcal energy, 28.09g carbohydrates, 26.08g proteins, 36.24g total fat and 12.2g dietary fiber. (USDA, 2014) This has been primarily due to phenomenal increase in human population and lower rate of production of this crop. The decline of soil fertility is the main cause of low productivity of the cultivated lands. So far the emphasis has been to supplement the soil with the major nutrients Viz., NPK, Sulphur and (Zn) micronutrient could be met from the soil reserve. According to soil test finding use of high analysis fertilizers, limited recycling of plant residues and gap between the removal and supplementation of secondary and micronutrient have resulted in widespread multiple nutrient deficiencies, especially of NPK, S and Zn.

The physical properties of soil play an important role in determining its suitability for crop production. The characteristics like support in power and bearing capacity, tillage practices, moisture storage capacity, drainage, ease of penetration by roots, aeration, retention of plant nutrient and its availability to plant. It includes bulk density, particle density, porosity, soil texture and soil colour too.

The nutrient elements of major significance for yield and quality of yellow mustard are nitrogen, phosphorus sulphur and Zinc. Nitrogen is the most important which determines the growth of yellow mustard that increases the amount of protein, methionine, dry matter and yield. (Singh et al., 2012) Phosphorus and potash are known to be efficiently utilized in the presence of nitrogen to promote flowering, setting of siliqua and increases the size of siliqua and yield. (Singh et al., 2012)

It is well known that sulphur is only next to nitrogen in the nutrition of Brassica crops. Sulphur requirement is higher than any other crops because the synthesis of thioglucosides and other related compounds present to the extent of about 3% of plant dry weight.

Sulphur plays a significant role in increasing production especially in oilseeds. Sulphur is essential for synthesis of sulphur containing amino acid viz., methionine, cystine and chlorophyll. It is also responsible for synthesis of certain vitamins (Thiamine, biotin), lipoid acid and glutathione's. It is essential for metabolism of carbohydrate, protein, oils and in synthesis of coenzyme-A.

The deficiency of Zinc is most widely spread as reported. (Thakkar *et al* 2005) Zinc deficiency is particularly reported from Punjab, tarai area of U.P., some parts of Haryana, Western U.P. and Delhi. If Zinc deficiency is acute, a dose of 50 kg $ZnSo_4$ ha^{-1} recommended. The Zinc is an essential component required in the biosynthesis of plant hormone viz. Indole acetic acid (IAA) and is a component of a variety of enzymes such as carbonic anhydrates, alcohol dehydrogenises etc. Zinc plays a role in the synthesis of nucleic acid and protein. It also helps in the utilization of phosphorus and nitrogen along with physiology of seed formation. The Zinc also maintains the semi-permeability of the cell membrane.

In views of these problems an investigation was undertaken to investigate the Interaction effect of different doses of Sulphur and Zinc with NPK on Physico – Chemical Properties of soil in Yellow Mustard (*Brassica compestris* L.) Var. Krishna Super Goldi.

MATERIALS AND METHODS

The experiment was conducted during *rabi season* of 2014-15 at Crop research farm Department of Soil Science Allahabad School of Agriculture SHIATS-DU Allahabad. The experimental site is located in the sub – tropical region with 25^0 27^1 N *latitude* 81^0 51^1 E longitudes and 98 meter the sea level *altitudes.* The experiment was laid out in a 3^2 RBD factorial design with three levels of each Sulphur and Zinc with nine treatments, each consisting of three replicates. The total number of plots was 27. Yellow Mustard **(*Brassica compestris* L.)** Cv. Krshna Super Goldi' were sown in Rabi season plots of size 2 x 2 m with row spacing 30 cm and plant to plant distance 10 cm. The Soil of experimental area falls in order of Inception and is alluvial in nature; both the mechanical and chemical analysis of soil was done before starting of the experiment to ascertain the initial fertility status. The soil samples were randomly collected from 0-15cm depths prior to tillage operations. The treatment consisted of nine combination of inorganic source of fertilizers T_1 (@ 15 kg S ha^{-1} + 1.35 kg Zn ha^{-1}), T_2 (@ 15 kg S ha^{-1} + 2.75 kg Zn ha^{-1}), T_3 (@ 15 kg S ha^{-1} + 5.5 kg Zn ha^{-1}), T_4 (@ 30 kg S ha^{-1} + 1.35 kg Zn ha^{-1}), T_5 (@ 30 kg S ha^{-1} + 2.75 kg Zn ha^{-1}), T_6 (@ 30 kg S ha^{-1} + 5.5 kg Zn ha^{-1}), T_7 (@ 45 kg S ha^{-1} + 1.35 kg Zn ha^{-1}),

T_8 (@ 45 kg S ha^{-1} + 2.75 kg Zn ha^{-1}), T_9 (@ 45 kg S ha^{-1} + 5.5 kg Zn ha^{-1}). The source of Sulphur and Zinc as Milvet Sulphur and Zinc sulphate respectively

Physical and Chemical Analysis of Soil Samples (Pre-Sowing)

Table 1: Physical Analysis of Soil

Particulars	Method Employed	Results
Sand (%)	Bouyoucous Hydrometer	68.00
Silt (%)	method **Bouyoucous (1927)**	17.50
Clay (%)		14.50
Textural class		Sandy loam
Bulk density (g m^{-3})	Graduated measuring cylinder **Black (1965)**	1.16
Particle density (g m^{-3})	Graduated measuring cylinder **Black (1965)**	2.32
Pore Space (%)	Graduated measuring cylinder **Black (1965)**	53.22

Table 2: Chemical Analysis of Soil Particulars Method Employed Results

Particulars	Method Employed	Results
pH (1:2)	Digital pH meter**(Jackson, 1958)**	7.24
EC (dS m^{-1})	EC meter (Digital Conductivity Meter) **(Wilcox, 1950)**	0.32
Organic Carbon (%)	**(Walkley and Black's** method **1947)**	0.49
Available Nitrogen (kg ha^{-1})	Alkaline potassium permanganate method (**Subbaih and Asija (1956)**	232.70
Available Phosphorus (kg ha^{-1})	Colorimetric method **(Olsen *et al.* 1954)**	17.96
Available Potassium (kg ha^{-1})	Flame photometric method **(Toth and Prince, 1949)**	258.00
Available Sulphur (kg ha^{-1})	Turbid metric Method **(Chesnin &Yien 1950)**	17.25
Available Zinc (kg ha^{-1})	Spectrophotometer (**Shaw and Dean 1952)**	2.25

RESULTS AND DISCUSSIONS

Physical Properties

Response on Bulk Density, Particle Density and Pore Space (%) of Soil after Crop Harvest

The result depicted in Table 3 shows that the maximum Db of soil (Mg m^{-3}), was found in T_8-(@ 45 kg S ha^{-1} + 2.75 kg Zn ha^{-1}) which was 1.30 and minimum was found in T_4-(@ 30 kg S ha^{-1} + 1.35 kg Zn ha^{-1}) which was 1.17 Mg m^{-3}. The interaction effect of Sulphur and Zinc with NPK on Db (Mg m^{-3}) of soil was found no significant. The results shows that the maximum Dp of soil (Mg m^{-3}), was found in T_2-(@ 15 kg S ha^{-1} + 2.75 kg Zn ha^{-1}) which was 2.76 and minimum was found in T_5-(@ 30 kg S ha^{-1} + 2.75 kg Zn ha^{-1}) which was 2.45 Mg m^{-3}. The interaction effect of Sulphur and Zinc with NPK on Dp (Mg m^{-3}) of soil were found significant. The results shows that the maximum pore space (%) of soil, was found in T_5-(@ 30 kg S ha^{-1} + 2.75 kg Zn ha^{-1}) which was 42.80 and minimum was found in T_4-(@ 30 kg S ha^{-1} + 1.35 kg Zn ha^{-1}) which was 39.36 . The interaction effect of Sulphur and Zinc with NPK on pore space (%) of soil were found significant.

Table 3: Soil Properties

Treatment	Ph (w/v)	EC (dSm^{-1})	Bulk Density ($Mg\ m^{-3}$)	Particle Density ($Mg\ m^{-3}$)	Pore Space (%)	Organic Carbon (%)	Nitrogen ($Kg\ ha^{-1}$)	Phosphorous ($Kg\ ha^{-1}$.)	Potassium ($Kg\ ha^{-1}$)	Sulphur ($Kg\ ha^{-1}$)	Zinc ($Kg\ ha^{-1}$.)
T_1	6.56	0.17	1.28	2.65	39.76	0.60	345.80	22.10	230.71	18.65	2.36
T_2	6.67	0.19	1.25	2.76	42.70	0.71	348.20	22.83	235.37	19.30	2.42
T_3	6.77	0.21	1.20	2.65	40.83	0.72	350.24	22.92	248.63	22.52	2.48
T_4	6.70	0.19	1.17	2.55	39.36	0.62	360.40	23.64	254.59	22.80	2.60
T_5	6.78	0.22	1.29	2.45	42.80	0.73	362.36	24.60	256.78	25.71	2.62
T_6	6.82	0.23	1.20	2.55	41.20	0.75	365.40	25.82	268.71	28.44	2.80
T_7	6.78	0.19	1.22	2.62	42.20	0.66	348.20	24.85	256.45	22.45	2.88
T_8	6.88	0.23	1.30	2.63	40.20	0.74	377.23	26.10	266.72	22.61	2.90
T_9	6.96	0.25	1.22	2.75	39.70	0.79	380.24	27.46	270.72	28.50	2.94
F-test	NS	NS	NS	S	S	NS	S	NS	S	NS	NS
S. Ed. (±)	0.214	0.045	0.040	0.018	0.360	0.141	0.923	0.720	0.827	0.974	0.110
C.D. (at 5%)	0.454	0.096	0.085	0.038	0.763	0.298	1.975	1.527	1.753	2.065	0.233

CHEMICAL PROPERTIES

Response on pH and EC at 25˚C (dSm^{-1}) of Soil after Crop Harvest

The result depicted in Table 3 shows that the pH and EC shows that the maximum pH and EC at 25˚C (dSm^{-1}) of soil was found in T_9-(@ 45 kg S ha^{-1} + 5.5 kg Zn ha^{-1}) which were 6.96 and 0.25 and minimum was found in T_1-(@ 15 kg S ha^{-1} + 1.35 kg Zn ha^{-1}) which were 6.56 and 0.17. The interaction effect of Sulphur and Zinc with NPK on pH and EC was found non significant.

Response of Organic Carbon (%), Available Nitrogen, Phosphorus, Potassium, Sulphur and Zinc ($kg\ ha^{-1}$) of Soil after Crop Harvest

The result depicted in Table 3 shows that the Maximum OC(%), available nitrogen, phosphorus, potassium, sulphur and zinc ($kg\ ha^{-1}$) in soil were found in T_9-(@ 45 kg S ha^{-1} + 5.5 kg Zn ha^{-1}) which were 0.79, 380.24, 27.46, 270.72, 28.50, 2.94 kg ha^{-1} respectively and minimum was found in T_1-(@ 15 kg S ha^{-1} + 1.35 kg Zn ha^{-1}) which were 0.60, 345.80, 22.10, 230.71, 18.65, 2.36 kg ha^{-1} respectively. The interaction effect of Sulphur and Zinc with NPK on available nitrogen and potassium ($kg\ ha^{-1}$) was found significant and the interaction effect of Sulphur and Zinc with NPK on OC(%), available phosphorus, sulphur and zinc ($kg\ ha^{-1}$) was found no significant. Combined application of Sulphur and Zinc NPK brings significantly increase in available Nitrogen and available Potassium. The results are conformity with the finding of Khambalkar *et al.* (2012).

CONCLUSIONS

It is concluded that Treatment combination T_9 (@ 45 kg Sulphur ha^{-1} + 5.5 kg Zinc ha^{-1}) was to be best in pH, EC (dSm^{-1}), O.C(%), available nitrogen ($kg\ ha^{-1}$), phosphorus ($kg\ ha^{-1}$), potassium ($kg\ ha^{-1}$), sulphur ($kg\ ha^{-1}$) and zinc ($kg\ ha^{-1}$) which were as 6.96, 0.24, 0.69, 380.24, 27.46, 270.72, 28.50, 2.94 respectively.. Soil chemical properties as available N and K were found to be significant but pH, EC, O C. (%), available P, S and Zn were found to be non significant. Soil physical properties as particle density ($Mg\ m^{-3}$) and percent pore space (%) were found to be significant where as bulk density ($Mg\ m^{-3}$) was found to be non significant.

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REFERENCES

1. ***Anonymous (2009-10)*** *Economic survey, Ministry of Finance, Government of India.*
2. ***Bharose, R., Chandra, S., Thomas, T. and Dhan, D. (2010)*** *Effect of different levels of phosphorus and sulphur on yield and availability of NPK protein and oil content in Tpria. (Brassica sp.) VAR. P.T.–303. ARPN Journal of Agricultural and Biological Science. Vol 6,No 2*
3. ***Black, C.A. (1965)*** *Methods of soil analysis vol.2, Am.Soc, Agron. madison, Wisconsin, U.S.A.*
4. ***Bouyoucos, G. L. (1927)****. The hydrometer as a new method for the mechanical analysis of soils. Soil sci.,* ***23****: 343-353.*
5. ***Fisher, R. A. (1950)*** *Technique of Analysis of Variance .Handbook of Agricultural Statistics. B-29- 110.*
6. ***Jackson, M.L. (1958)*** *Soil chemical analysis. Second edition Indian Reprint, prentice hall of India, New Dehli. pp 498.*
7. ***Khambalkar, H. (2012)*** *Characterization of some cotton growing soils ofWardhadistrictofVidharbha region (M.S., India). Journal of Soils and Crops; 22: 1, 159-167. 20.*
8. ***Meena,P.D.,Chattopadhyay,C.,Kumar,K.,Awasthi,R.P.,Singh,R.,Kaur,S.,Thomas,L.,Goyal,P.and Chand.P.,(2011)*** *Comparative study on the effect of chemicals on Alternaria blight in Indian mustard – A multi-location study in India. Jou.Environ.Biol.32,375-379*
9. ***Olsen, S. R., Cole, C. V., Watanhe, F. S. and Dean, L. A. (1954)*** *Estimation of available Phosphorus in soils by extraction with sodium bicarbonate U. S. Deptt. Agr. Circ., 939*
10. ***Singh, C., Singh, P. and Rajbir, S. (2010)*** *Oil crops of mustard (Brassica juncea L.) General Introduction Modern techniques of raising field crops. Oxford & IBH publishing Company Pvt. Ltd. New Delhi. p.273-291*
11. ***Singh, J., Singh, N.S.H. and Bhadauria, H.S. (2012)*** *Nitrogen and sulphur requirement of mustard under different crop sequences. Ann. Pl. Soil Res. 14(2): 113-115*
12. ***Subbiah, B. V. and Asija, G. L. (1956)*** *A rapid procedure for the estimate of Available nitrogen in soil current sciences.****25****:259-260.*
13. ***Thakkar, D.P, Smile and M. (2005)*** *Reclamation of Zinc. Journal of Indian society of Soil Science. 2005, 36:2, 311-312 ref.*
14. ***Toth, S.J. and Prince, A. L. (1949)*** *Estimate of Cation exchange capacity and exchangeable Ca, K, Na, content of soil by flame photometer technique soil sci.67: pp 439-445.*
15. ***Walkley, A. and Black, I. A. (1947)*** *Critical examination of rapid method for determining organic carbon in soils, effect of variance in digestion conditions and of inorganic soil constituents. Soil sci pp...632:251.*
16. ***Wilcox, L. V. (1950)*** *Electrical conductivity Am. water works Assoc. J 42,775-776.*